A project report

On

Follow Me Multifunctional Automated Trolley

Submitted in partially fulfilment in the award of

DIPLOMA

IN

ELECTRICAL ENGINEERING

Submitted by

Mohd Ahsan	1722064009
Anurag	1722064005
Pavneet singh	1722064012
Rahul Rathore	1722064013

Under guidance of
Er. Farazuddin siddiqui
&
Under the supervision of
Er. Mohd Yasir

SESSION 2019-2020

Department of Electrical Engineering

University polytechnic, centre Shahjahanpur

INTEGERAL UNIVERSITY, LUCKNOW

CERTIFICATE

This is to certify that our team which is comprised of four student of final year **DIPLOMA IN ELECTRICAL ENGINEERING** in this university is presenting a project on**“Follow Me Multifunctional Automated Trolly”** as our final year project during the session 2019-2020.

This project is completed for the award of **DIPLOMA IN ELECTRICALENGINEERING** from Integral University Campus, Shahjahanpur.

(H.O.D)
Er Faraz Khan

Project Supervisor
Er. Mohd. Yasir

Project guide
Farazuddin siddiqui

Electrical Engineering Department
Integral University –Lucknow
Polytechnic Centre shahjahanpur

ACKNOWLEDGEMENT

I would like to express my sincere thanks to my project Guide and HOD **Er. Faraz Khan** Department of Electrical Engineering, integral university Center, Shahjahanpur for his constant support, timely help, guidance, sincere co-operation during the entire period of my work. I am gratefull to him for providing all necessary facilities during the course of the project work.

I would like to pay my sincere thanks to Mr. **Imamuddin** for providing his valueable support during formatting & content editing of the project report.

My special thanks goes to in-charge polytechnic **Dr. Naseem** & Project supervisor **Er.Mohd. Yasir** for his full support from time to time in making this project. Apart from this **Er.Faraz Uddin Siddiqui, Er. Syed Ahmad Rafey and Er. Mohd Irfan Khan** are also indebted to my heartily thanks.

I am also thankful to my loving parents and my colleagues for their moral support & timely help.

AHSAN
ANURAG
PAVNEET SINGH
RAHUL RATHORE
Electrical Engineering
University Polytechnic-Center Shahjahanpur

ABSTRACT

Nowadays, supermarkets are almost developed with many technological advancements. People purchase different items from the supermarkets and put them into a trolley because it is the easiest method used in supermarkets to carry goods. However, throughout the whole process of shopping, customer must push the trolley manually by their own effort and when it comes to the billing process customers must wait in long queues to pay their bills. This is a time wasting process due to the busy schedule of people. To avoid these problems the research group have introduced an effective and highly advance system. Although there are some existing Smart Trolleys which includes some of the above mentioned aspects there is no proper multifunctional automated trolley to make shopping life easier. The research “Follow Me” has developed a multifunctional trolley which makes shopping life easier and convenient to customers. Follow Me consists of series of technologies such as automatic human guided travelling with use of an Arduino Mega, goods tracking and billing with the help of a Bar code reader and an android based tablet with extensive User Interface (UI) techniques. Furthermore, Follow Me consists of automatic parking to its slot and automatic charging while the trolley is parked in the slot. The research group has provided an accurate, user friendly smart shopping trolley to make customers shopping life more convenient and easier.

Keywords: Supermarkets, Trolley, Billing, Multifunctional, Follow Me, User Interface (UI) techniques, Arduino card, Bar code reader, Automatic parking, Automatic charging

INTEGRAL UNIVERSITY LUCKNOW
I. C. P. E.

COMPONENT USED

Sr. no	**NAME OF COMPONENT**	**QUANTITY**
1	Microcontroller 89s52	1
2	Read switch	1
3	Resistance 1k	1
4	Diode 4007	1
5	Crystal oscillator 12MHZ	1
6	Transistor bc 547	1
7	Wire 1 mm	AS REQUIRED
8	Regulator 7805	1

TABLE OF CONTENT

CERTIFICATE i

ACKNOWLEDGEMENT ii

ABSTRACT iii

COMPONENT USED iv

TABLE OF CONTENT v-vi

CHAPTER -1 ABOUT PROJECT 1-5

- Introduction 1-2
- Literature review 3-5

CHAPTER -2 METHODOLOGY 6-8

Planning

- Requirements Gathering and Analysis
- Designing
- Implementation
- Testing

CHAPTER -3 COMPONENT DISCRIPTION 9-39

Microcontroller 9

Reed switch 10

Magnetic sensors 11

Resistor 12-15

3.5 Diode 16-31

3.6 DC Motor 32
3.7 Wheel 33
3.8 Crystal oscillator 34
3.9 BC547 Transistor 35-36
3.10 Regulator 7805 37
3.11 Battery connector 38
3.12 Pvc board 39

CHAPTER 4 –DISCUSSION 40
CHAPTER 5 – CONCLUSION 41-42
CHAPTER 6- FUTURE WORK 43

REFERENCE

INTEGRAL UNIVERSITY, LUCKNOW
I. C. P. E.

CHAPTER-1 ABOUT PROJECT

INTRODUCTION

Shopping carts in the supermarkets in day today shopping activities is now mostly visible. Customers are pushing trolleys around them to carry the items they purchased. The usual process of travelling the trolley is done manually by the human with the effort of his/her. Therefore, if a customer carries a baby while doing shopping it is a real burden to the customer to push the trolley or to a disabled person with one hand is almost impossible to push the trolley. People can see huge rush in supermarkets on holidays and weekends the rush is even more when there are special offers and discounts. The main purpose of the research project was to address the above issues by developing a multi-functional automated trolley.

Follow Me is an automated trolley that is capable of carrying goods while following the customer automatically without human effort, an android application has developed which gives suggestions about goods while purchasing, for this a tablet is fixed to the trolley with an android platform to function the above-mentioned task. Furthermore, the trolley is parking back to its slot automatically after the customer finishes his/her purchases, the trolley will be charged its battery automatically while the trolley is in the parking slot. Usage of this system will impact on modern day shopping market customers to do their shopping activities in an easy manner.

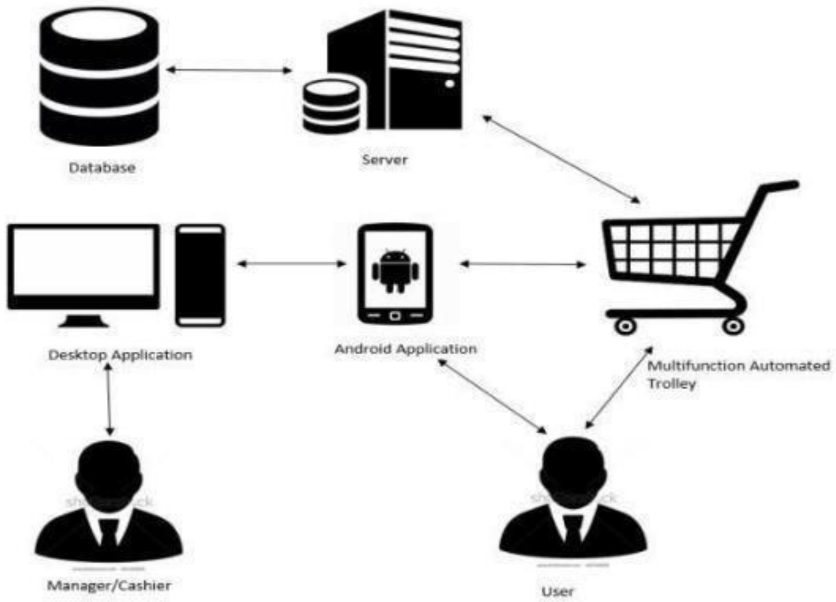


Fig 1 :- Architecture Diagram

According to the Figure 01, there are mainly two users who are interacting with the system. Customer will interact with the android system while using the trolley to get product details, prices and suggestions to the mobile device for the currently purchased items. The details are getting from the database where the details are being stored. Manager and the cashier is interacting with the desktop application as a helpmate to the customer to finalize the bill. All the above mentioned data are taken from a hosted database and a server.

INTEGRAL UNIVERSITY, LUCKNOW
I. C. P. E.

LITREATURE REVIEW

An automatic line following trolley, this trolley is being guided behind the customer with use of traditional line following techniques. Considering the functional facts that they developed, the research group developed an automated trolley which follows the customer with use of an Arduino mega to ride the trolley the research group came up with the methodology sensors to track the path which the customers walks. Moreover, the developed research consists of a tablet which is fixed in front of the trolley to track the goods which the customers purchased and automatic billing system which is developed with use of Android operating system. Furthermore, the trolley to be developed is consisting of some multifunctional tasks of automatic parking to the slot and automatic charging while the trolley is being parked [1]. Electronic shopping cart based on Radio Frequency Identification (RFID) technology. This trolley contains a function to track the goods eg. Viewing the product name, expiry date and the cost, to display the items they have used a Liquid Crystal Display (LCD) screen. The drawback of the system is the trolley does only the functions that are mentioned above. Thus the trolley is electronic it does not cover the automatic travelling facility .

System designed to track the purchased items using a Quick Response (QR) code which developed a trolley to track the goods and do the automatic billing with the help of an electronic display. Through this system it does the billing process but the research is not completed with a fully automated trolley. However, the battery of the trolley must be charged manually. Considering these facts designed a trolley which saves man power is essential.

Multitasking shopping trolley with use of RFID technology. This is embedded with the aspect automatic product identification and billing. To track the products, it uses the technology RFID which contains readers and tags placed on the products. Though this identify the product through RFID the proposed system uses bar code reader to track the goods. Considering all the facts this trolley does not perform multitasks as it describes. The developed research is based on more functionalities that is more time consuming and easy to handle .

A system named Intelligent Shopping Cart developed using RFID technology in additionally this module consist of a technology Zigbee go get product details from the main server. This project improves the time consumption such as it reduces the time which waste on long queues to pay the bills. Although the system consumes the time, developed trolley which travels automatically saves more time and human power .

IOT Based Intelligent Trolley which is developed in India is tracking the purchases using RFID tags. When a customer puts any goods into the trolley the RFID tags will detect the product and will display the specifications of the product. A system with RFID tags are placed in all the trolleys. All the products in the mall are equipped with RFID tags. Therefore, there is no way to travel the trolley automatically but to put goods the trolley.

Shopping and automatic billing using RFID technology was developed by Vidyavardhaka College of Engineering in India. They have come up with an architecture with Radio frequency identification (RFID) and wireless technology to provide on spot billing in super markets. It uses the RFID based system application in the shopping trolley and the RFID tags which is used security of the products. A Liquid crystal display (LCD) that is fixed to the trolley displays the product name, cost and the total of all purchased products. The bill is transmitted to the server end through the ZigBee technology. There's no Automatic travelling system to the trolley. The research group has focused only in purchase tracking and billing only .

This research was developed for disabled customers. The research group implemented a trolley which follows the customer. To chase the customer accurately and measure the position a laser beam and laser range sensor is used. A gyro-sensor and a rotary encoder also used for fared chasing and have developed a mapping algorithm and an estimation method for searching the position of the customer. This trolley is capable of following the customer only.

Automated shopping trolley which can control using a remote. The structure of this trolley consist of robotic structure and a keypad which is used to navigate the trolley along the particular way. The Keypad has the inbuilt product code reader to read the bar codes and track the goods purchased. The wireless billing system is made up of the ZigBee communication module.

Smart shopping cart for automated billing purpose, this cart is using wireless sensors and image comparison algorithm to calculating the bill without involving a human. Customer does not need to waste their time staying in long queues to pay the bill. The cart cannot follow the human automatically. The developed research based on an automatic path finding trolley integrated with some functionalities such as an android performing tablet which is fixed to the trolley to keep track of purchased goods and automatic bill generating. Furthermore, the trolley is embedded with automatic parking and automatic charging while the trolley is parked in the slot .

Shopping trolley with smart shopping system to reduce the time wastage of customer and to make the shopping life easier for the customer. This automatic trolley is using Ultrasonic sensors to identify obstacle avoidance and android application to control. Moreover, this system helps users to find the products location which users RFID tags and readers for the identification phase .

Varsha Jalkote et al., developed a futuristic billing trolley with using RFID and ZIGBEE technologies. Whenever customer put a product into the trolley RFID scanner scanned it and product cost and the price bill displayed on the Liquid Crystal Display (LCD). By using ZIGBEE transmitter it takes product details which is stored in the main computer server of the supermarket. Thus the system is intelligent with the billing criteria it does not cover the aspects of the developed research –Follow Me‖ .

An automated patient cart navigation system to hospitals using active RFID technology, Arduino card and IR sensors. The purpose of the research is operating the patient cart without wasting human power. Navigation part is done by RFID tags and readers. Considering the above mentioned facts research group developed an automated trolley the main criteria that differs from the patient cart is that the system only navigates within the given path. The developed trolley follows the customer where ever the place he/she walks .

Automatic shopping cart to reduce the time consuming in supermarkets and malls. Whenever the customer puts a product to the trolley RFID reader scanned it and product price and cost displayed on LCD. ZIGBEE transmitter and receiver used to make a connection between trolley and main computer server. Considering the research done by Mr.Yathisha and the group they has focused mainly on billing aspect. The developed trolley can automatically follow the customer too.

Intelligent trolley for automatic billing in malls using RFID technology and internet server. The methodology that they have used is when a customer puts a product into trolley RFID reader scanned it and connect with the internet server. Then the billing part is done in the trolley itself. Product name and cost displayed on a LCD. Thus the system is intelligent with the billing area it does not cover than the developed research –Follow Me‖ .

Most developed trolleys are developed using traditional line following methodology. Since this some supermarkets have no way to use this technology it‘s difficult to use the line following technique in the whole supermarket. Furthermore, tracking the purchased goods in the trolley and billing system with help of android mobile device fixed to the trolley. Most of the researchers are developed to track the purchased goods but few trolleys perform both aspects goods tracking and automatic billing. After purchasing is done by the customer trolley parks to its slot automatically.

CHAPTER -2 METHODOLOGY

According to the research papers that the research group went through no trolley performs automatic parking facility after the purchases are finished by the customers. Moreover, while the trolley is parked within the slot its battery will charge automatically. Since the research is based on an electronic device its battery must be charged to get work from it. According to the developed trolleys the battery is charged manually with help of a human to plug the device. Considering all the facts the research group came up with an intelligent trolley which performs multifunctional tasks to make shopping life easier.

The prototype methodology was used to achieve the project goals. Planning, Analysis, Designing and Implementation phases were executed concurrently and iterated until the project reached all the objectives and the users were satisfied with a final prototype.

First prototype was built with minimal amount of features and the rest of the features were added to each prototype produced.

Planning

The planning phase is the most critical and essential step in the software development life cycle (SDLC). As a starting point to the SDLC research problem was found and as a solution for the problem an automatic trolley with an android and a desktop application was proposed. In the planning phase the research team identified the project value and problems and divided the work among the members in the group.

Technology was chosen in order to build the project and a budget was calculated

Requirements Gathering and Analysis

During the requirements gathering phase the research group collected raw data of approximately 1500 goods which holds in the supermarket to extract the data mining terminology. These data contains the prices of the goods, item identification and the name of the goods. The stratified sampling method was used to prepare a questionnaire to gather information from supermarket customers. Individuals who are coming to the supermarkets daily were given the online questionnaire. While gathering the requirements the research group gathered information as primary and secondary data gathering which helped the group to identify the solutions. As discussed above the primary data gathering was done using the questionnaire which was given to the customers. Secondary data were gathered via the literature review done related to previous research which were similar products as the

Follow Me research. With all the analysed factors Follow Me robot was developed with a combination of software and hardware components.

Designing

Designing phase was the place where the initial design of the project was planned. The sketch of the automated trolley was designed, how the hardware components are placed and how it will be connected to software. All the main functionalities such as automatic following, sensor fixing, line following methodology to park the trolley also the android and the desktop applications designs was planned. The application design contains tracking the purchased goods, suggestions for the currently purchased goods, bill generating, add goods and report generating. Finally the integration between the hardware and software was planned. As the final step of designing Arduino IDE (Integrated Development Environment) was finalized to develop the hardware programming, Android studio was finalized to develop the android application and Microsoft Visual Studio was finalized to develop the desktop application. Overall design for the project is stated in Chapter I Figure .

Implementation

The goal was the implement a user friendly system which works efficiently and effectively. Arduino IDE was used to implement the hardware programming of the system, Android Studio was used to implement the android application and Microsoft Visual Studio was used to implement the desktop application. As the very step the trolley was implemented to move automatically to follow an object Sharp IR sensors was used to implement the automatic following methodology and obstacle identification while travelling. As the implementation going on the research group developed the automatic parking methodology by reading the black line using IR sensors. Furthermore, the research group developed an android application for customers use. The application consist of major functionalities such as details of the goods to track this barcode scanner is used and the application consist of automatic suggestion for the goods that are currently purchased by the customer. Suggestion part was implemented using data mining methodology and the mined data is stored in a hosted web server so the android application pulls the data from the web server when customer requests for suggestions. All the data is stored to the database and for the billing process, add products and to view reports a desktop application was built. All the data which are taken from the android application are stored in the database and through web services all the details are taken to the desktop to print the final bill to the customer. Moreover through the desktop application the manager of the supermarket can view the reports of their sales and he/she can add products if needed.

Testing

–Follow Me‖ automated trolley was tested using two testing methods. In unit testing each and every function was tested individually. As per testing first the research group tested whether the trolley is following the customer automatically in a correct manner. In integration testing, whole trolley and the software applications were tested along with the functionalities to make sure that the whole system is working properly without any errors.

INTEGRAL UNIVERSITY, LUCKNOW
I. C. P. E.

CHAPTER -3 COMPONENT DISCRIPTION

Microcontroller

A microcontroller (MCU for microcontroller unit) is a small computer on a single metal-oxide-semiconductor (MOS) integrated circuit chip. In modern terminology, it is similar to, but less sophisticated than, a system on a chip (SoC); a SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the internet of things, microcontrollers are an economical and popular means of data collection, sensing and actuating the physical world as edge devices.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

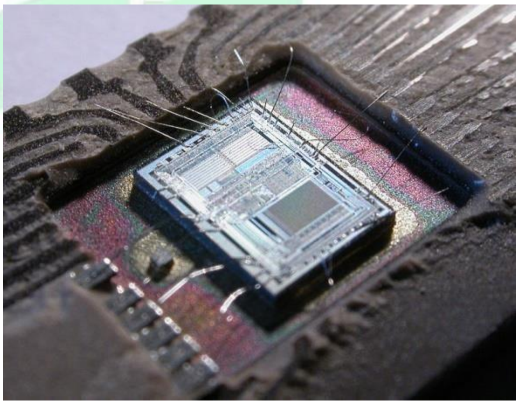


Fig 2:- Microcontroller

Reed switch

The reed switch is an electrical switch operated by an applied magnetic field. It was invented at Bell Telephone Laboratories in 1936 by Walter B. Ellwood. In its simplest and most common form, it consists of a pair of ferromagnetic flexible metal contacts in a hermetically sealed glass envelope. The contacts are usually normally open, closing when a magnetic field is present, or they may be normally closed and open when a magnetic field is applied. The switch may be actuated by an electromagnetic coil, making a reed relay,[1] or by bringing a permanent magnet near it. When the magnetic field is removed, the contacts in the reed switch return to their original position.

The reed is the metal part inside the reed switch envelope that is relatively thin and wide to make it flexible. It somewhat resembles part of some reed plants. The term "reed" may also include the external wire lead as well as the internal part.

An example of a reed switch application is to detect the opening of a door, when used as a proximity switch for a security alarm.

he most common type of reed switch contains a pair of magnetizable, flexible, metal reeds whose end portions are separated by a small gap when the switch is open. The reeds are hermetically sealed within a tubular glass envelope. Another type of reed switch contains one flexible reed that moves between a fixed normally-open contact and a fixed normally-closed contact. The normally-closed contact is non-ferromagnetic and is closed by the flexible reed's spring force. Although reed switches with multiple poles are possible, more often an assembly of single-pole reed switches is used for multi-pole applications.

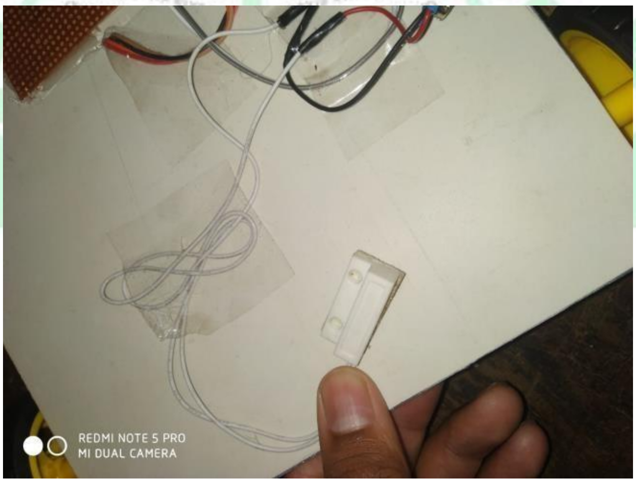


Fig 3:-Reed switch

Magnetic sensors

Reed switches actuated by magnets are commonly used in mechanical systems as proximity sensors. Examples are door and window sensors in burglar alarm systems and tamperproofing methods. Reed switches have been used in laptops to put the laptop into sleep/hibernation mode when the lid is closed. Speed sensors on bicycle wheels frequently use a reed switch to actuate briefly each time a magnet on the wheel passes the sensor. Reed switches were formerly used in the keyboards for computer terminals, where each key had a magnet and a reed switch actuated by depressing the key. Electric and electronic pedal keyboards used by pipe organ and Hammond organ players often use reed switches, where the glass enclosure of the contacts protects them from dirt, dust, and other particles. They may also be used to control diving equipment, such as flashlights or cameras, which must be sealed to keep water out under high pressure.

At one time brushless DC electric motors used reed switches to sense the rotor's position relative to the field poles.[2] This allowed switching transistors to act as a commutator, but without the contact problems, wear and electrical noise of a traditional DC commutator. The motor design could also be "inverted", placing permanent magnets onto the rotor and switching the field through the external, fixed coils. This avoided the need for any rubbing contact to provide power to the rotor. Such motors were used in low-power long-service-life items, such as computer cooling fans and disk drives. As cheap Hall effect sensors became available, they replaced the reed switches and gave even longer service lifetimes.

Reed switches are used in at least one brand of endoscopic capsule to switch on the power source only when the unit is removed from the sterile packaging.

Reed switches may be selected for a particular sensor application when a solid-state device does not meet requirements such as power consumption or electrical interface compatibility.

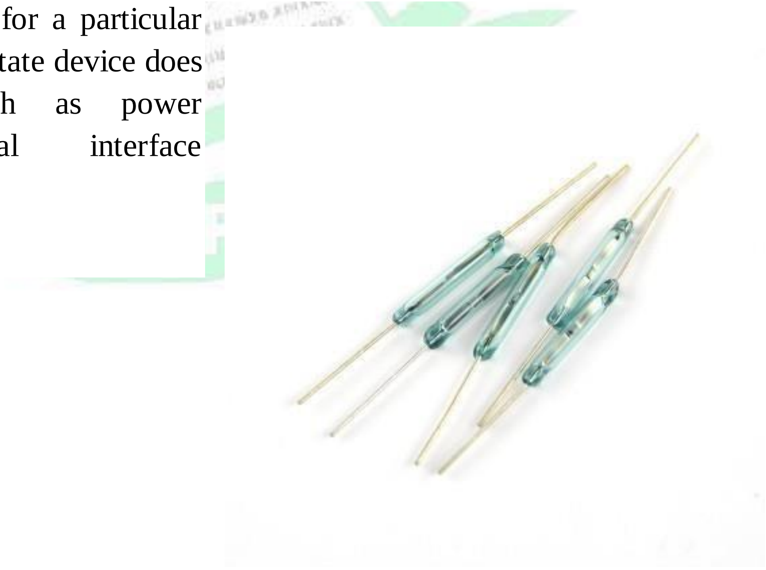


Fig 4:- Magnetic sensor

Resistor

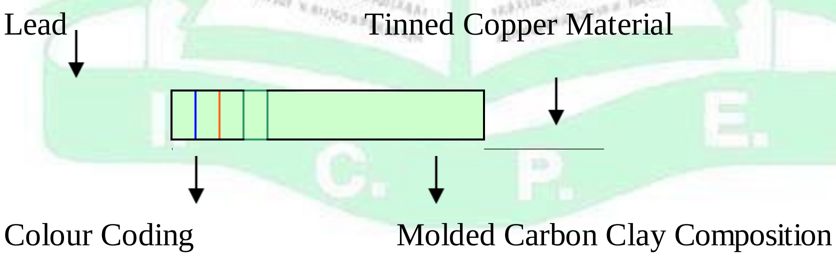
Resistors are used to limit the value of current in a circuit. Resistors offer opposition to the flow of current. They are expressed in ohms for which the symbol is _Ω‘. Resistors are broadly classified as

(1) Fixed Resistors
(2) Variable Resistors

Fixed Resistors :

The most common of low wattage, fixed type resistors is the molded-carbon composition resistor. The resistive material is of carbon clay composition. The leads are made of tinned copper. Resistors of this type are readily available in value ranging from few ohms to about 20MΩ, having a tolerance range of 5 to 20%. They are quite inexpensive. The relative size of all fixed resistors changes with the wattage rating.

Another variety of carbon composition resistors is the metalized type. It is made by deposition a homogeneous film of pure carbon over a glass, ceramic or other insulating core. This type of film-resistor is sometimes called the precision type, since it can be obtained with an accuracy of ±1%.



Fixed Resistor

A Wire Wound Resistor :

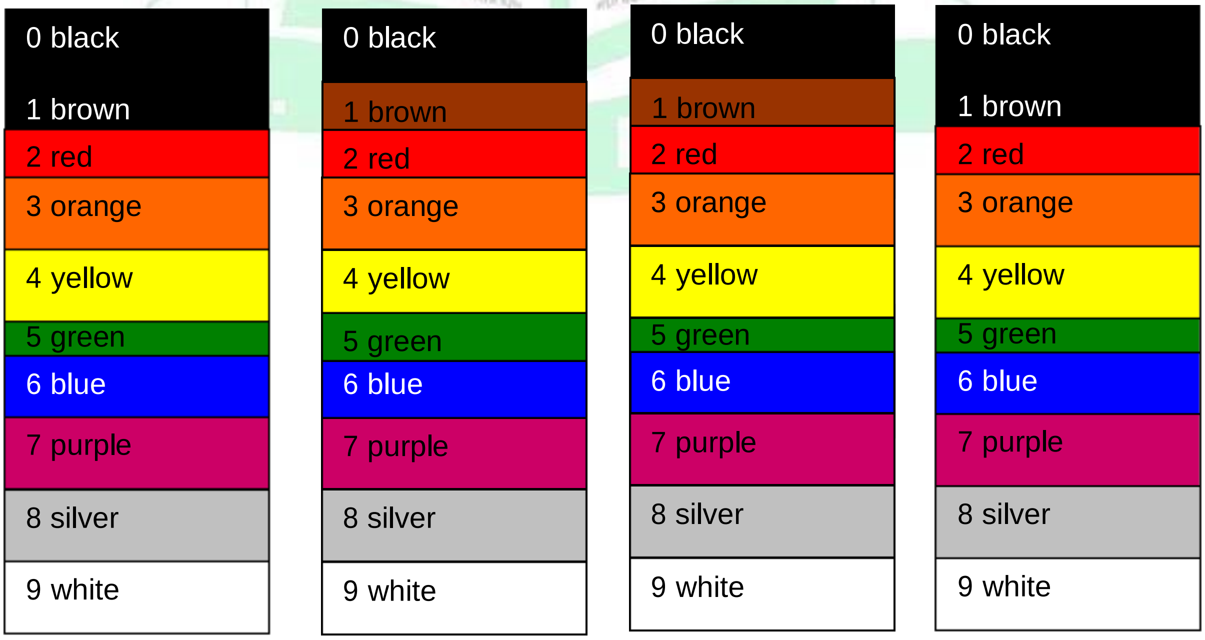
It uses a length of resistance wire, such as nichrome. This wire is wounded on to a round hollow porcelain core. The ends of the winding are attached to these metal pieces inserted in the core. Tinned copper wire leads are attached to these metal pieces. This assembly is coated with an enamel coating powdered glass. This coating is very smooth and gives mechanical protection to winding. Commonly available wire wound resistors have resistance values ranging from 1Ω to 100KΩ, and wattage rating up to about 200W.

Coding Of Resistor :

Some resistors are large enough in size to have their resistance printed on the body. However there are some resistors that are too small in size to have numbers printed on them. Therefore, a system of colour coding is used to indicate their values. For fixed, moulded composition resistor four colour bands are printed on one end of the outer casing. The colour bands are always read left to right from the end that has the bands closest to it. The first and second band represents the first and second significant digits, of the resistance value. The third band is for the number of zeros that follow the second digit. In case the third band is gold or silver, it represents a multiplying factor of 0.1to 0.01. The fourth band represents the manufacture‘s tolerance.

INTEGRAL UNIVERSITY LUCKNOW

RESISTOR COLOUR CHART



0 black	0 black	0 black	0 black
1 brown	1 brown	1 brown	1 brown
2 red	2 red	2 red	2 red
3 orange	3 orange	3 orange	3 orange
4 yellow	4 yellow	4 yellow	4 yellow
5 green	5 green	5 green	5 green
6 blue	6 blue	6 blue	6 blue
7 purple	7 purple	7 purple	7 purple
8 silver	8 silver	8 silver	8 silver
9 white	9 white	9 white	9 white

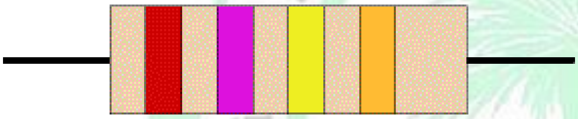
For example, if a resistor has a colour band sequence: yellow, violet, orange and gold

Then its range will be—

Yellow=4, violet=7, orange=10^3, gold=±5% =47KΩ ±5% =2.35KΩ

Most resistors have 4 bands:

- The first band gives the first digit.
- The second band gives the second digit.
- The third band indicates the number of zeros.
- The fourth band is used to show the tolerance (precision) of the resistor.



This resistor has red (2), violet (7), yellow (4 zeros) and gold bands. So its value is 270000 Ω 270 k .Ω

The standard colour code cannot show values of less than 10Ω. To show these small values two special colours are used for the third band: gold, which means × 0.1 and silver which means × 0.01. The first and second bands represent the digits as normal.

For example:

red, violet, gold bands represent 27 × 0.1 = 2.7 Ω

blue, green, silver bands represent 56 × 0.01 = 0.56 Ω

The fourth band of the colour code shows the tolerance of a resistor. Tolerance is the precision of the resistor and it is given as a percentage. For example a 390Ω resistor with a tolerance of ±10% will have a value within 10% of 390 Ω between 390 - 39 = 351 Ω and 390 + 39 = 429Ω (39 is 10% of 390).

INTEGRAL UNIVERSITY, LUCKNOW I. C. P. E.

A special colour code is used for the fourth band tolerance: silver ±10%, gold ±5%, red ±2%, brown ±1%. If no fourth band is shown the tolerance is ±20%.

VARIABLE RESISTOR:

In electronic circuits, sometimes it becomes necessary to adjust the values of currents and voltages. For n example it is often desired to change the volume of sound, the brightness of a television picture etc. Such adjustments can be done by using variable resistors.

Although the variable resistors are usually called rheostats in other applications, the smaller variable resistors commonly used in electronic circuits are called potentiometers.

Diode

Theory of operation

A laser diode, like many other semiconductor devices, is formed by doping a very thin layer on the surface of a crystal wafer. The crystal is doped to produce an n-type region and a p-type region, one above the other, resulting in a *p-n* junction, or diode.

Laser diodes form a subset of the larger classification of semiconductor *p-n* junction diodes. As with *any* semiconductor *p-n* junction diode, forward electrical bias causes the two species of charge carrier – holes and electrons – to be "injected" from opposite sides of the *p-n* junction into the depletion region, situated at its heart. Holes are injected from the *p*-doped, and electrons from the *n*-doped, semiconductor. (A depletion region, devoid of any charge carriers, forms automatically and unavoidably as a result of the difference in chemical potential between *n*- and *p*-type semiconductors wherever they are in physical contact.)

As charge injection is a distinguishing feature of diode lasers as compared to all other lasers, diode lasers are traditionally and more formally called "injection lasers." (This terminology differentiates diode lasers, e.g., from flashlamp-pumped solid state lasers, such as the ruby laser. Interestingly, whereas the term "solid-state" was extremely apt in differentiating 1950s-era semiconductor electronics from earlier generations of vacuum electronics, it would not have been adequate to convey unambiguously the unique characteristics defining 1960s-era semiconductor lasers.) When an electron and a hole are present in the same region, they may recombine or "annihilate" with the result being spontaneous emission — i.e., the electron may re-occupy the energy state of the hole, emitting a photon with energy equal to the difference between the electron and hole states involved. (In a conventional semiconductor junction diode, the energy released from the recombination of electrons and holes is carried away as phonons, i.e., lattice vibrations, rather than as photons.) Spontaneous emission gives the laser diode below lasing threshold similar properties to an LED. Spontaneous emission is necessary to initiate laser oscillation, but it is one among several sources of inefficiency once the laser is oscillating.

The difference between the photon-emitting semiconductor laser and conventional phonon-emitting (non-light-emitting) semiconductor junction diodes lies in the use of a different type of semiconductor, one whose physical and atomic structure confers the possibility for photon emission. These photon-emitting semiconductors are the so-called "direct bandgap" semiconductors. The properties of silicon and germanium, which are single-element semiconductors, have bandgaps that do not align in the way needed to allow photon emission and are not considered "direct." Other materials, the so-called compound semiconductors, have virtually identical crystalline structures as silicon or germanium but use alternating arrangements of two different atomic species in a checkerboard-like pattern to break the symmetry. The transition between the materials in the alternating pattern creates the critical "direct bandgap" property. Gallium arsenide, indium phosphide, gallium antimonide, and gallium nitride are all examples of compound semiconductor materials that can be used to create junction diodes that emit light.

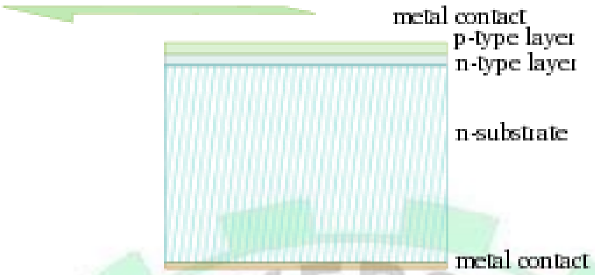


Diagram of a simple laser diode, such as shown above.

In the absence of stimulated emission (e.g., lasing) conditions, electrons and holes may coexist in proximity to one another, without recombining, for a certain time, termed the "upper-state lifetime" or "recombination time" (about a nanosecond for typical diode laser materials), before they recombine. Then a nearby photon with energy equal to the recombination energy can cause recombination by stimulated emission. This generates another photon of the same frequency, travelling in the same direction, with the same polarization and phase as the first photon. This means that stimulated emission causes gain in an optical wave (of the correct wavelength) in the injection region, and the gain increases as the number of electrons and holes injected across the junction increases. The spontaneous and stimulated emission processes are vastly more efficient in direct bandgap semiconductors than in indirect bandgap semiconductors; therefore silicon is not a common material for laser diodes.

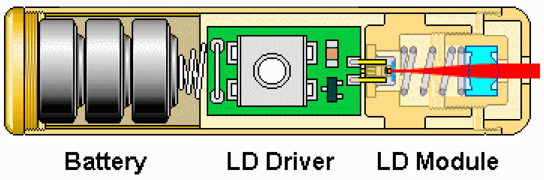
As in other lasers, the gain region is surrounded with an optical cavity to form a laser. In the simplest form of laser diode, an optical waveguide is made on that crystal surface, such that the light is confined to a relatively narrow line. The two ends of the crystal are cleaved to form perfectly smooth, parallel edges, forming a Fabry–Pérot resonator. Photons emitted into a mode of the waveguide will travel along the waveguide and be reflected several times from each end face before they are emitted. As a light wave passes through the cavity, it is amplified by stimulated emission, but light is also lost due to absorption and by incomplete reflection from the end facets. Finally, if there is more amplification than loss, the diode begins to "lase".

Some important properties of laser diodes are determined by the geometry of the optical cavity. Generally, in the vertical direction, the light is contained in a very thin layer, and the structure supports only a single optical mode in the direction perpendicular to the layers. In the lateral direction, if the waveguide is wide compared to the wavelength of light, then the waveguide can support multiple lateral optical modes, and the laser is known as "multi-mode". These laterally multi-mode lasers are adequate in cases where one needs a very large amount of power, but not a small diffraction-limited beam; for example in printing, activating chemicals, or pumping other types of lasers.

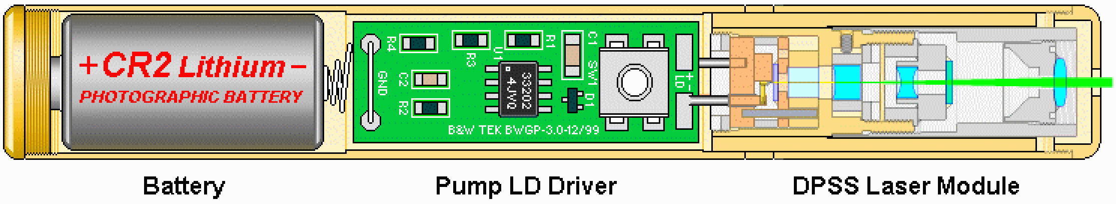
In applications where a small focused beam is needed, the waveguide must be made narrow, on the order of the optical wavelength. This way, only a single lateral mode is supported and one ends up with a diffraction-limited beam. Such single spatial mode devices are used for optical storage, laser pointers, and fiber optics. Note that these lasers may still support multiple longitudinal modes, and thus can lose at multiple wavelengths simultaneously. The wavelength emitted is a function of the band-gap of the semiconductor and the modes of the optical cavity. In general, the maximum gain will occur for photons with energy slightly above the band-gap energy, and the modes nearest the gain peak will lose most strongly. If the diode is driven strongly enough, additional *side modes* may also lase. Some laser diodes, such as most visible lasers, operate at a single wavelength, but that wavelength is unstable and changes due to fluctuations in current or temperature.

Due to diffraction, the beam diverges (expands) rapidly after leaving the chip, typically at 30 degrees vertically by 10 degrees laterally. A lens must be used in order to form a collimated beam like that produced by a laser pointer. If a circular beam is required, cylindrical lenses and other optics are used. For single spatial mode lasers, using symmetrical lenses, the collimated beam ends up being elliptical in shape, due to the difference in the vertical and lateral divergences. This is easily observable with a red laser pointer. The simple diode described above has been heavily modified in recent years to accommodate modern technology, resulting in a variety of types of laser diodes, as described below.

POINTER DESIGN



Typical Red Laser Pointer



Typical Green Laser Pointer

Comparison of Red and Green Laser Pointer Complexity

MICROCONTROLLER AT89C51/89s52

Features

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Re programmable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

DESCRIPTION

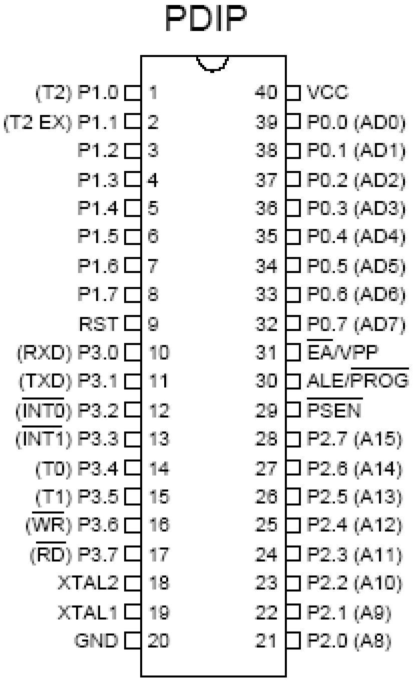
The AT89s52 is a low-power, high-performance CMOS 8-bit microcomputer 8Kbytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel 's high-density nonvolatile memory technology and is compatible with the industry standard 80C51 and 80C52 instruction set and pin out.

The on-chip Flash allows the program memory to be reprogrammed in-system or by a Conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer that provides a highly flexible and cost-effective solution to many embedded control application.

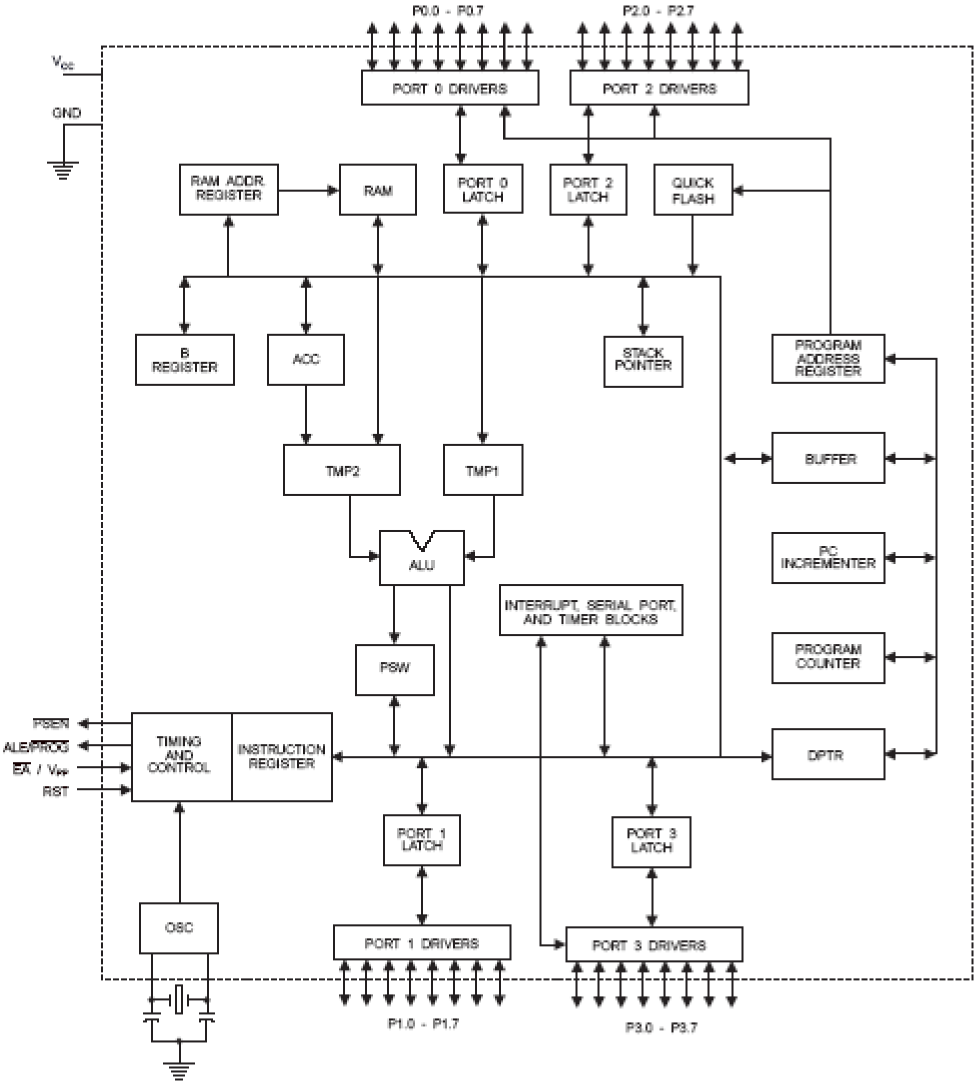
The AT89C52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full-duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode tops the CPU while allowing the RAM; timer/counters, serial port, and interrupt system to continue functioning.

The Power-down mode saves the RAM contents but Freezes the oscillator, disabling all other chip functions until the next hardware reset

INTEGRAL UNIVERSITY, LUCKNOW
I. E.



Block Diagram



Pin Description

VCC
Supply voltage.

GND
Ground.

Port 0

Port 0 is an 8-bit open drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs.

Port 0 can also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups .

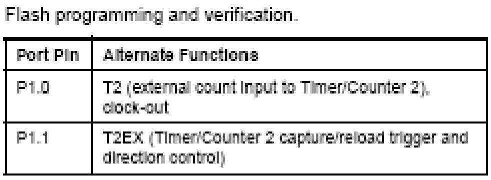
Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

INTEGRAL UNIVERSITY, LUCKNOW

Port 1

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX), respectively, as shown in the following table.



Flash programming and verification.

Port Pin	Alternate Functions
P1.0	T2 (external count input to Timer/Counter 2), clock-out
P1.1	T2EX (Timer/Counter 2 capture/reload trigger and direction control)

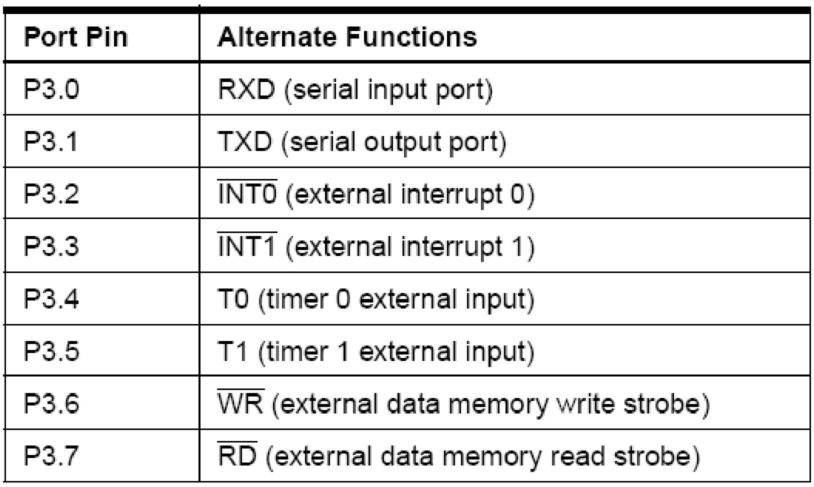
Port 1 also receives the low-order address bytes during

Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also serves the functions of various special features of the AT89C51, as shown in the following table. Port 3 also receives some control signals for Flash programming.



Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

INTEGRAL UNIVERSITY, LUCKNOW

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG

Address Latch Enable is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the micro controller is in external execution mode.

PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.

Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset.

EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming when 12-volt programming is selected.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

Output from the inverting oscillator amplifier .

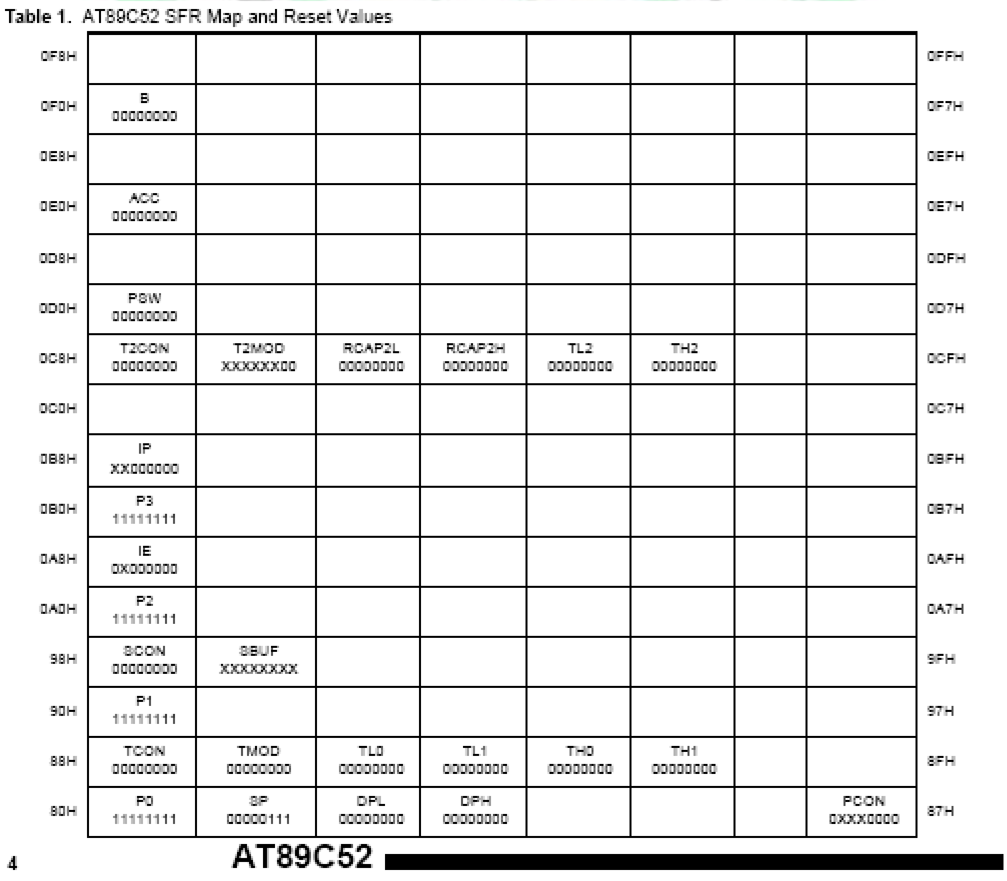


Table 1. AT89C52 SFR Map and Reset Values

0F8H									0FFH
0F0H	B 00000000								0F7H
0E8H									0EFH
0E0H	ACC 00000000								0E7H
0D8H									0DFH
0D0H	PSW 00000000								0D7H
0C8H	T2CON 00000000	T2MOD XXXXXX00	RCAP2L 00000000	RCAP2H 00000000	TL2 00000000	TH2 00000000			0CFH
0C0H									0C7H
0B8H	IP XX000000								0BFH
0B0H	P3 11111111								0B7H
0A8H	IE 0X000000								0AFH
0A0H	P2 11111111								0A7H
98H	SCON 00000000	SBUF XXXXXXXX							9FH
90H	P1 11111111								97H
88H	TCON 00000000	TMOD 00000000	TL0 00000000	TL1 00000000	TH0 00000000	TH1 00000000			8FH
80H	P0 11111111	SP 00000111	DPL 00000000	DPH 00000000				PCON 0XXX0000	87H

4 AT89C52

Special Function Registers

A map of the on-chip memory area called the Special Function Register (SFR) space is shown in Table 1.

Note that not all of the addresses are occupied, and unoccupied addresses may not be implemented on the chip. Read accesses to these addresses will in general return random data, and write accesses will have an indeterminate effect. User software should not write 1s to these unlisted locations, since they may be used in future prod new features. In that case, the reset or inactive values of the new bits will always be 0.

Timer 2 Registers

Control and status bits are contained in registers T2CON (shown in Table 2) and T2MOD (shown in Table 4) for Timer 2. The register pair (RCAP2H, RCAP2L) are the Capture/Reload registers for Timer 2 in 16-bit capture mode or 16-bit auto-reload mode.

Interrupt Registers

The individual interrupt enable bits are in the IE register. Two priorities can be set for each of the six interrupt sources in the IP register. Instructions that use indirect addressing access the upper 128 bytes of RAM. For example, the following indirect addressing instruction, where R0 contains 0A0H, accesses the data byte at address 0A0H, rather than P2 (whose address is 0A0H).

MOV @R0, #data

Note that stack operations are examples of indirect addressing, so the upper 128 bytes of data RAM are avail available as stack space.

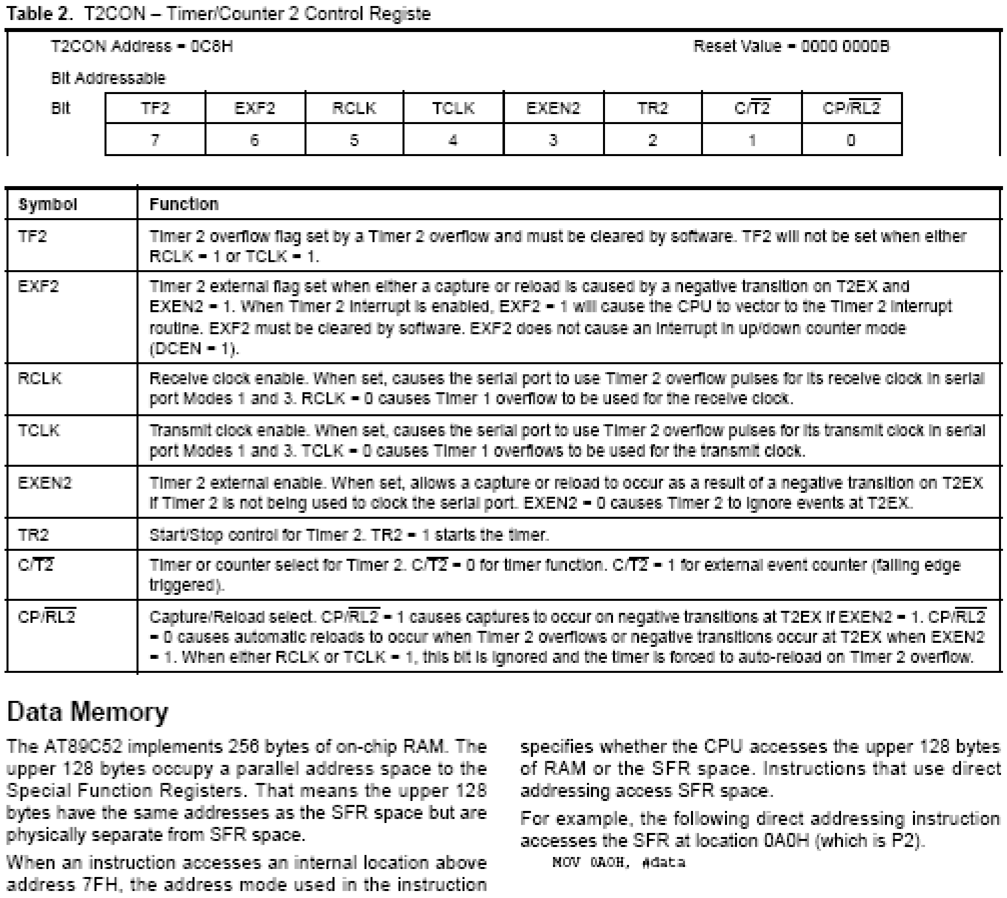


Table 2. T2CON – Timer/Counter 2 Control Registe

T2CON Address = 0C8H　　Reset Value = 0000 0000B

Bit Addressable

Bit								
	TF2	EXF2	RCLK	TCLK	EXEN2	TR2	$C/\overline{T2}$	$CP/\overline{RL2}$
	7	6	5	4	3	2	1	0

Symbol	Function
TF2	Timer 2 overflow flag set by a Timer 2 overflow and must be cleared by software. TF2 will not be set when either RCLK = 1 or TCLK = 1.
EXF2	Timer 2 external flag set when either a capture or reload is caused by a negative transition on T2EX and EXEN2 = 1. When Timer 2 interrupt is enabled, EXF2 = 1 will cause the CPU to vector to the Timer 2 interrupt routine. EXF2 must be cleared by software. EXF2 does not cause an interrupt in up/down counter mode (DCEN = 1).
RCLK	Receive clock enable. When set, causes the serial port to use Timer 2 overflow pulses for its receive clock in serial port Modes 1 and 3. RCLK = 0 causes Timer 1 overflow to be used for the receive clock.
TCLK	Transmit clock enable. When set, causes the serial port to use Timer 2 overflow pulses for its transmit clock in serial port Modes 1 and 3. TCLK = 0 causes Timer 1 overflows to be used for the transmit clock.
EXEN2	Timer 2 external enable. When set, allows a capture or reload to occur as a result of a negative transition on T2EX if Timer 2 is not being used to clock the serial port. EXEN2 = 0 causes Timer 2 to ignore events at T2EX.
TR2	Start/Stop control for Timer 2. TR2 = 1 starts the timer.
$C/\overline{T2}$	Timer or counter select for Timer 2. $C/\overline{T2}$ = 0 for timer function. $C/\overline{T2}$ = 1 for external event counter (falling edge triggered).
$CP/\overline{RL2}$	Capture/Reload select. $CP/\overline{RL2}$ = 1 causes captures to occur on negative transitions at T2EX if EXEN2 = 1. $CP/\overline{RL2}$ = 0 causes automatic reloads to occur when Timer 2 overflows or negative transitions occur at T2EX when EXEN2 = 1. When either RCLK or TCLK = 1, this bit is ignored and the timer is forced to auto-reload on Timer 2 overflow.

Data Memory

The AT89C52 implements 256 bytes of on-chip RAM. The upper 128 bytes occupy a parallel address space to the Special Function Registers. That means the upper 128 bytes have the same addresses as the SFR space but are physically separate from SFR space.

When an instruction accesses an internal location above address 7FH, the address mode used in the instruction specifies whether the CPU accesses the upper 128 bytes of RAM or the SFR space. Instructions that use direct addressing access SFR space.

For example, the following direct addressing instruction accesses the SFR at location 0A0H (which is P2).

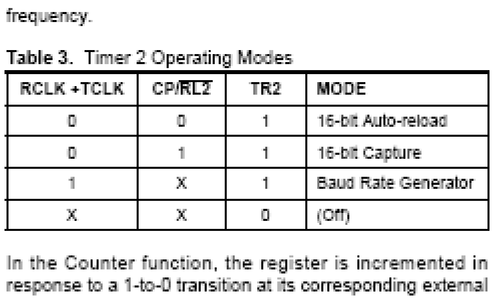
```
MOV 0A0H, #data
```

Timer 0 and 1

Timer 0 and Timer 1 in the AT89C52 operate the same way as Timer 0 and Timer 1 in the T89C51.

Timer 2

Timer 2 is a 16-bit Timer/Counter that can operate as either a timer or an event counter. The type of operation is selected by bit C/T2 in the SFR T2CON (shown in Table 2).Timer 2 has three operating modes: capture, auto-reload (up or down counting), and baud rate generator. The modes are selected by bits in T2CON, as shown in Table 3.Timer 2 consists of two 8-bit registers, TH2 and TL2. In the Timer function, the TL2 register is incremented every machine cycle. Since a machine cycle consists of 12 oscillator periods, the count rate is 1/12 of the oscillator input pin, T2. In this function, the external input is sampled during S5P2 of every machine cycle. When the samples show a high in one cycle and a low in the next cycle, the count is incremented. The new count value appears in the register during S3P1 of the cycle following the one in which the transition was detected. Since two machine cycles (24 oscillator periods) are required to recognize a 1-to-0 transition, the maximum count rate is 1/24 of the oscillator frequency. To ensure that a given level is sampled at least once before it changes, the level should be held for at least one full machine cycle.



frequency.

Table 3. Timer 2 Operating Modes

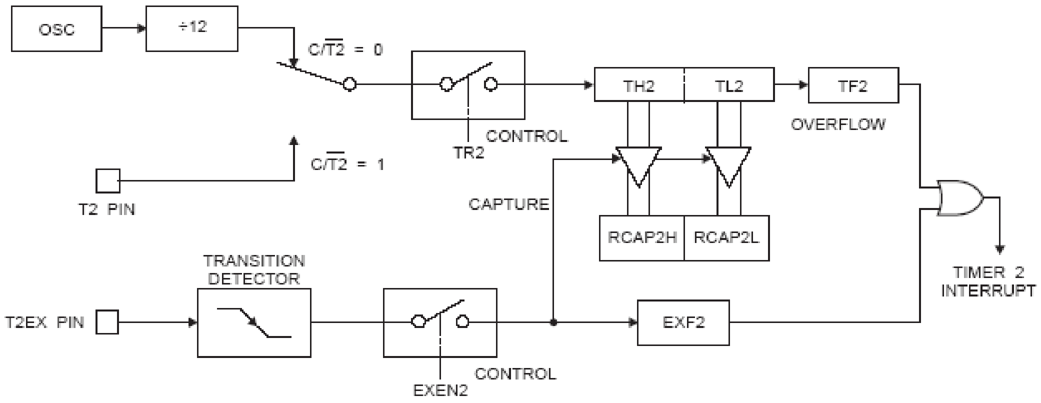
RCLK +TCLK	CP/$\overline{RL2}$	TR2	MODE
0	0	1	16-bit Auto-reload
0	1	1	16-bit Capture
1	X	1	Baud Rate Generator
X	X	0	(Off)

In the Counter function, the register is incremented in response to a 1-to-0 transition at its corresponding external

Capture Mode

In the capture mode, two options are selected by bit EXEN2 in T2CON. If EXEN2 = 0, Timer 2 is a 16-bit timer or counter which upon overflow sets bit TF2 in T2CON.This bit can then be used to generate an interrupt. If EXEN2 = 1, Timer 2 performs the same operation, but a 1-to-0 transition at external input T2EX also causes the current value in TH2 and TL2 to be captured into CAP2H and RCAP2L, respectively. In addition, the transition at T2EX causes bit EXF2 in T2CON to be set. The EXF2 bit, like TF2, can generate an interrupt. The capture mode is illustrated in Figure 1.

Figure 1. Timer in Capture Mode



Auto-reload (Up or Down Counter)

Timer 2 can be programmed to count up or down when configured in its 16-bit auto-reload mode. This feature is invoked by theDCEN (Down Counter Enable) bit located in the SFR T2MOD (see Table 4). Upon reset, the DCEN bit is set to 0 so that timer 2 will default to count up. When DCEN is set, Timer 2 can count up or down, depending on the value of the T2EX pin.

Figure 2 shows Timer 2 automatically counting up when DCEN = 0. In this mode, two options are selected by bitEXEN2 in T2CON. If EXEN2 = 0, Timer 2 counts up to 0FFFFH and then sets the TF2 bit upon overflow. The overflow also causes the timer registers to be reloaded with the 16-bit value in RCAP2H and RCAP2L. The values in Timer in Capture ModeRCAP2H and RCAP2L are preset by software. If EXEN2 = 1, a 16-bit reload can be triggered either by an overflow or by a 1-to-0 transition at external input T2EX. This transition also sets the EXF2 bit. Both the TF2 and EXF2 bits can generate an interrupt if enabled. Setting the DCEN bit enables Timer 2 to count up or down, as shown in Figure 3. In this mode, the T2EX pin controls

the direction of the count. A logic 1 at T2EX makes Timer 2 count up. The timer will overflow at 0FFFFH and set the TF2 bit. This overflow also causes the 16-bit value in RCAP2H and RCAP2L to be reloaded into the timer registers, TH2 and TL2, respectively. A Logic 0 at T2EX makes Timer 2 count down. The timer underflows when TH2 and TL2 equal the values stored in RCAP2H and RCAP2L. The underflow sets the TF2 bit and causes 0FFFFH to be reloaded into the timer Registers. The EXF2 bit toggles whenever Timer 2 overflows or underflows and can be used as a 17th bit of resolution. In this operating mode, EXF2 does not flag an interrupt.

Figure 2. Timer 2 Auto Reload Mode (DCEN = 0)

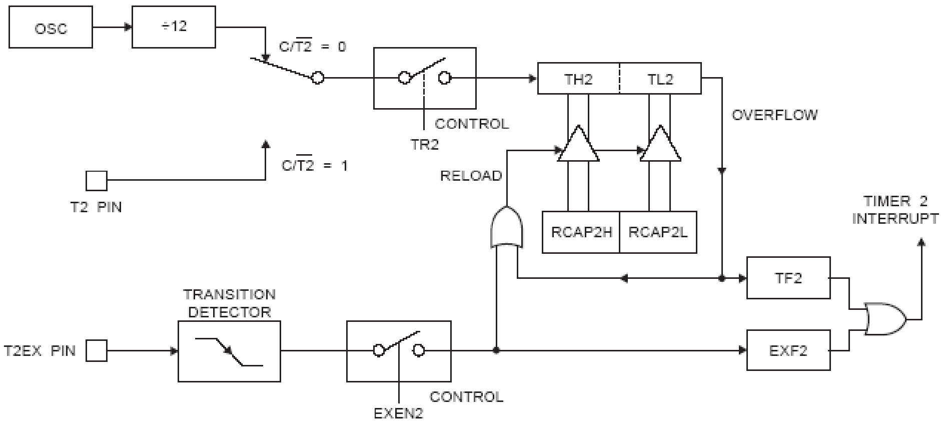


Table 4. T2MOD – Timer 2 Mode Control Register

T2MOD Address = 0C9H Reset Value = XXXX XX00B

Not Bit Addressable

	–	–	–	–	–	–	T2OE	DCEN
Bit	7	6	5	4	3	2	1	0

Symbol	Function
–	Not implemented, reserved for future
T2OE	Timer 2 Output Enable bit.
DCEN	When set, this bit allows Timer 2 to be configured as an up/down counter.

Figure 3. Timer 2 Auto Reload Mode (DCEN = 1)

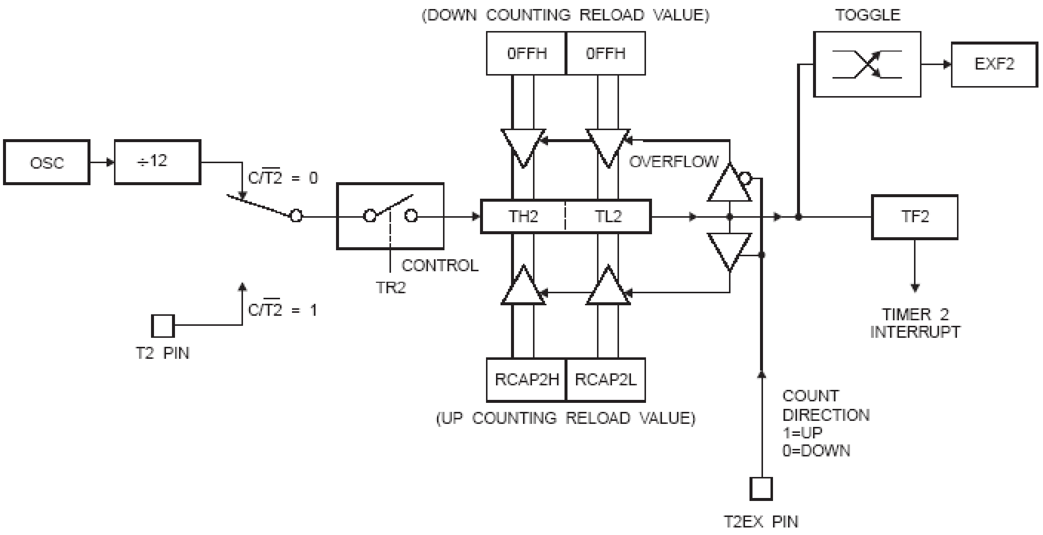
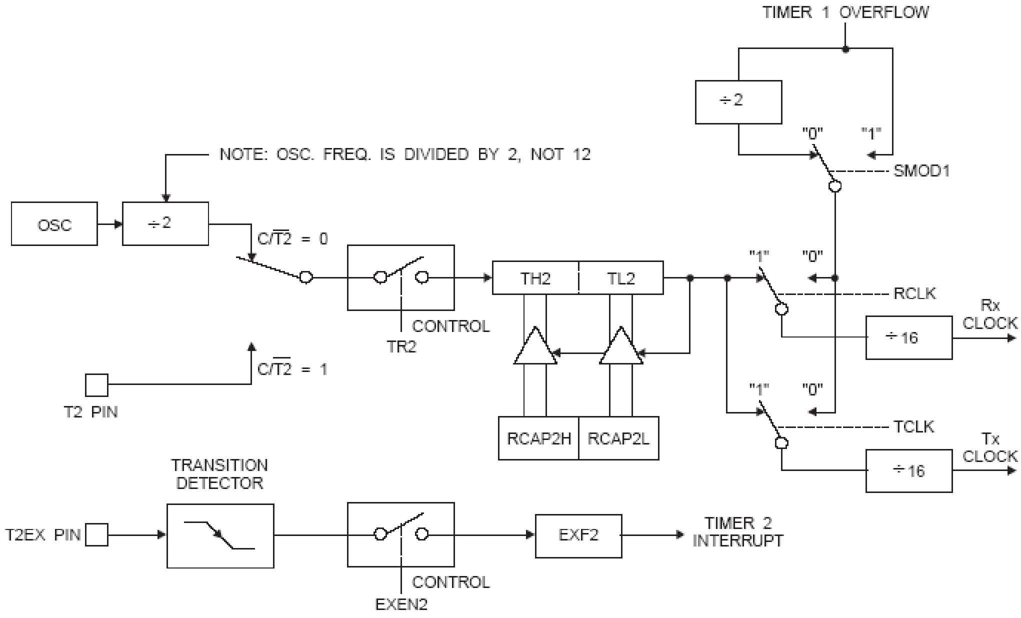


Figure 4. Timer 2 in Baud Rate Generator Mode



DC Motor

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

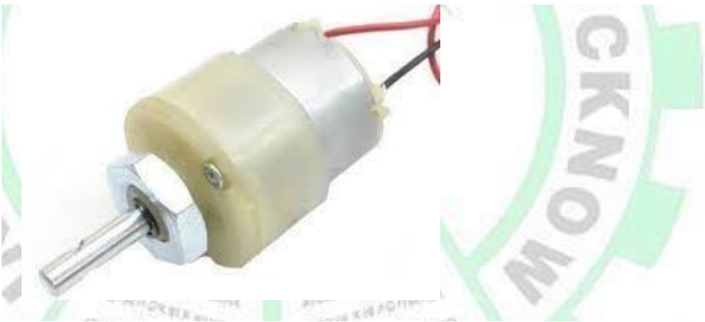


Fig 5:- DC Motor

Wheel

In its primitive form, a wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axle makes it possible to transport heavy loads; when placed horizontally, the wheel turning on its vertical axle makes it possible to control the spinning motion used to shape materials (e.g. a potter's wheel); when mounted on a column connected to a rudder or a chassis mounted on other wheels, one can control the direction of a vessel or vehicle (e.g. a ship's wheel or steering wheel); when connected to a crank, the wheel produces or transmits energy (e.g. the flywheel).

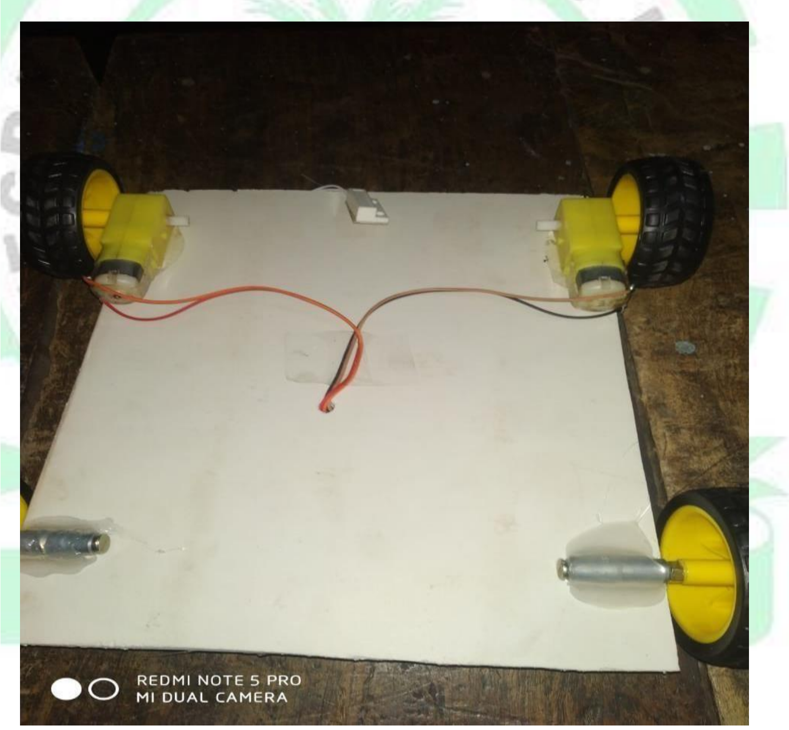


Fig 6:-Wheel

Crystal oscillator

A **crystal oscillator** is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

A crystal oscillator, particularly one using a quartz crystal, works by distorting the crystal with an electric field, when voltage is applied to an electrode near or on the crystal; a property known as electrostriction or inverse piezoelectricity. When the electric field is removed, the quartz—which oscillates at a precise frequency—generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit, but with a much higher Q.

Quartz crystals are manufactured for frequencies from a few tens of kilohertz to hundreds of megahertz. More than two billion crystals are manufactured annually. Most are used for consumer devices such as wristwatches, clocks, radios, computers, and cellphones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes.

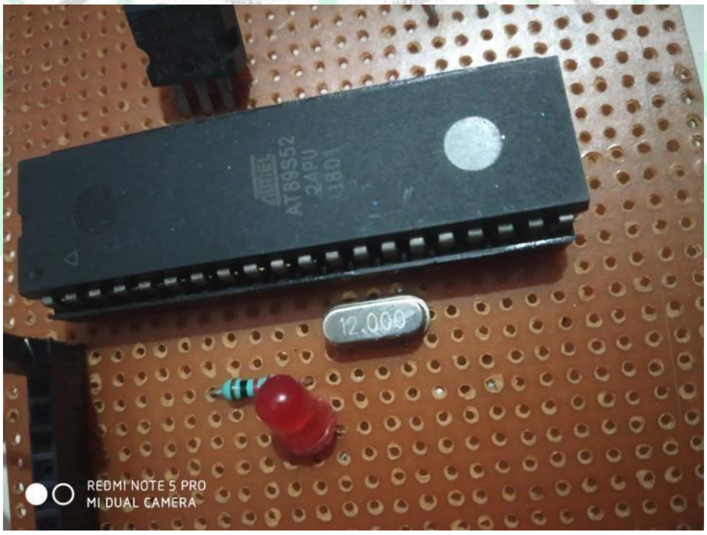
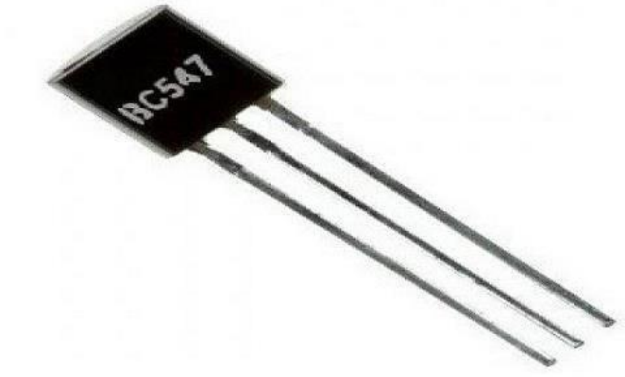


Fig 7:- Crystal oscillator

BC547 Transistor

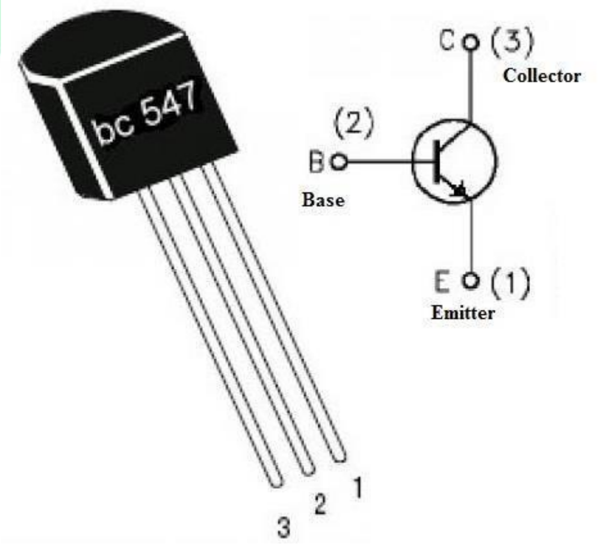
The BC547 transistor is an NPN transistor. A transistor is nothing but the transfer of resistance which is used for amplifying the current. A small current of the base terminal of this transistor will control the large current of emitter and base terminals. The main function of this transistor is to amplify as well as switching purposes. The maximum gain current of this transistor is 800A.



The similar transistors are like BC548 & BC549. This transistor works in a fixed DC voltage in the preferred region of its characteristics which is called the biasing. Further, the series of this transistor can be divided into three groups based on the current gain like BC547A, BC547B & BC547C.

BC547 Transistor Pin Configuration

The BC547 transistor includes three pins which include the following.

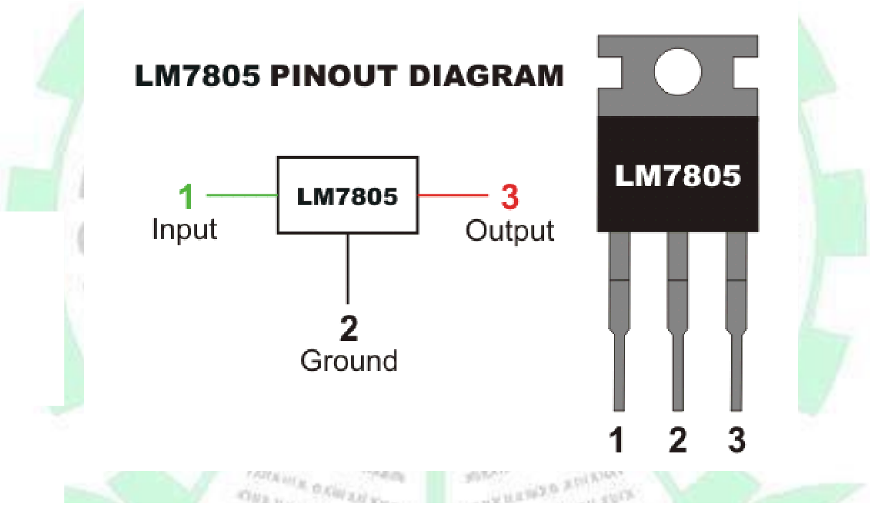


- Pin1 (Collector): This pin is denoted with symbol _C‘ and the flow of current will be through the collector terminal.
- Pin2 (Base): This pin controls the transistor biasing.
- Pin3 (Emitter): The current supplies out through emitter terminal

Regulator 7805

All voltage sources cannot able to give fixed output due to fluctuations in the circuit. For getting constant and steady output, the voltage regulators are implemented. The integrated circuits which are used for the regulation of voltage are termed as voltage regulator ICs. Here, we can discuss the IC 7805.

The **voltage regulator IC 7805** is actually a member of the 78xx series of voltage regulator ICs. It is a fixed linear voltage regulator. The xx present in 78xx represents the value of the fixed output voltage that the particular IC provides. For 7805 IC, it is +5V DC regulated power supply. This regulator IC also adds a provision for a heat sink. The input voltage to this voltage regulator can be up to 35V, and this IC can give a constant 5V for any value of input less than or equal to 35V which is the threshold limit.



PIN1-INPUT

The function of this pin is to give the input voltage. It should be in the range of 7V to 35V. We apply an unregulated voltage to this pin for regulation. For 7.2V input, the PIN achieves its maximum efficiency.

PIN 2-GROUND

We connect the ground to this pin. For output and input, this pin is equally neutral (0V).

PIN 3-OUTPUT

Battery connector

Battery terminals are the electrical contacts used to connect a load or charger to a single cell or multiple-cell battery. These terminals have a wide variety of designs, sizes, and features that are often not well documented.

Automotive batteries typically have one of three types of terminals.

In recent years, the most common design was the *SAE Post*, consisting of two lead posts in the shape of truncated cones, positioned on the top of the battery, with slightly different diameters to ensure correct electrical polarity.

The "JIS" type is similar to the SAE but smaller, once again positive is larger than negative but both are smaller than their SAE counterparts. Most older Japanese cars were fitted with JIS terminals.

General Motors, and other automobile manufacturers, have also begun using side-post battery terminals, which consist of two recessed female 3/8" threads (SAE 3/8-16) into which bolts or various battery terminal adapters are to be attached. These side posts are of the same size and do not prevent incorrect polarity connections.

L terminals consist of an L-shaped post with a bolt hole through the vertical side. These are used on some European cars, motorcycles, lawn and garden devices, snowmobiles, and other light duty vehicles.

Some batteries sizes are available with terminals in many different configurations, but two main configurations are:

1. positive on left and negative on right corner
2. negative on left and positive on right corner.

Terminals can also be both on the long or short side of the battery, or diagonally opposed, or in the middle. Purchasing the wrong configuration may prevent battery cables from reaching the battery terminals.

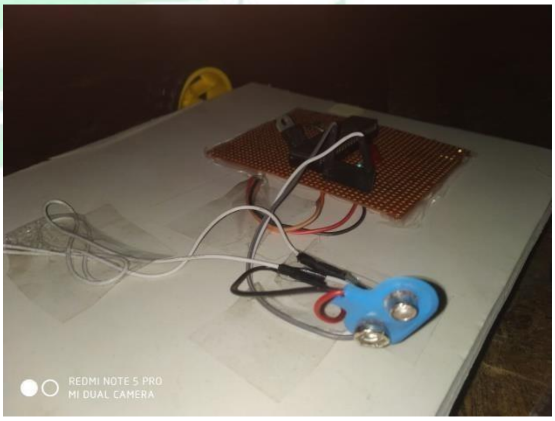


Fig 8:-Battery connector

Pvc board

Polyvinyl chloride (/ˌpɒlivaɪnəl ˈklɔːraɪd/; colloquial: polyvinyl, vinyl; abbreviated: PVC) is the world's third-most widely produced synthetic plastic polymer (after polyethylene and polypropylene. About 40 million tons of PVC are produced each year.

PVC comes in two basic forms: rigid (sometimes abbreviated as RPVC) and flexible. The rigid form of PVC is used in construction for pipe and in profile applications such as doors and windows. It is also used in making bottles, non-food packaging, food-covering sheets, and cards (such as bank or membership cards). It can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is also used in plumbing, electrical cable insulation, imitation leather, flooring, signage, phonograph records, inflatable products, and many applications where it replaces rubber. With cotton or linen, it is used in the production of canvas.

PVC was accidentally synthesized in 1872 by German chemist Eugen Baumann. The polymer appeared as a white solid inside a flask of vinyl chloride that had been left exposed to sunlight. In the early 20th century the Russian chemist Ivan Ostromislensky and Fritz Klatte of the German chemical company Griesheim-Elektron both attempted to use PVC in commercial products, but difficulties in processing the rigid, sometimes brittle polymer thwarted their efforts. Waldo Semon and the B.F. Goodrich Company developed a method in 1926 to plasticize PVC by blending it with various additives. The result was a more flexible and more easily processed material that soon achieved widespread commercial use.

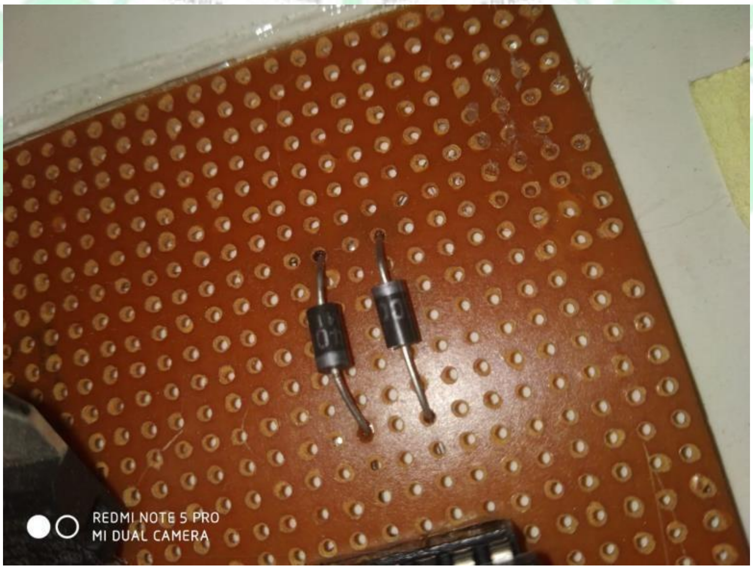


Fig 8:-PVC Board

CHAPTER 4 -DISCUSSION

Human Computer Interaction technology is very well developed in the current era. Follow Me robot was developed to follow the customer automatically while the customer performs shopping activities in the supermarket. When customer gets the trolley it follows the customer automatically with the help of Sharp IR sensors which is fixed to the Arduino Mega board. Through the sharp IR sensor the distance will be identified within the customer and the trolley. Moreover, to identify the obstacles again the Sharp IR sensors were used. Line following methodology was used to perform the automatic parking facility. To perform this task the research group used IR sensors in order to identify the black line. Arduino UNO was used to develop the line following methodology and all the sensors were fixed to the Arduino UNO board.

The research group developed an android application and a desktop application for the use of customers and staff. Android application was developed using Android Studio IDE and this application was developed for the use of the customer. Through this application customers can purchase goods with use of a bar code scanner and the android application is capable of showing the customers suggestion with regard to the goods that are currently purchased by the customer. To develop the suggestions the research group used Business Intelligent Studio IDE and the algorithm used to develop the suggestions was Decision Tree. All the data is stored in a hosted database and it was taken to the android application using Json. Desktop application was developed for the use of supermarket staff this was developed using Microsoft Visual Studio IDE and the language the research group used was C#, through this application the Manager can add goods to the store. Furthermore, this application is capable of storing all the details which was entered by the customer while purchasing goods. All the details is taken to the desktop application with use of web services. So that the staff can finally print the bill to the customer without wasting any time since the android application sends all the purchased item details to the desktop application via web services.

CHAPTER 5 - CONCLUSION

Supermarkets in the world plays a major role when it comes for shopping and the supermarkets which exist in the market implement many things to compete with other supermarkets. –Follow Me‖ automated smart trolley provides some benefits to the supermarkets as well as to the customers.

―Follow Me‖ trolley consist of some multifunctional tasks such as it is able to follow the customers automatically so that the customer does not needs to push the trolley manually. –Follow Me‖ has an android application which helps the customers to track the goods details tasks which the android application perform has been described in section III part D. An important event that this trolley performs is the automatic parking. After the customer finished their purchases the trolley move back to its slot automatically without any helpmate. Line following methodology was used by the research group to implement the automatic parking technology. All the above mentioned functions and technologies were used to fulfil all the objectives of this –Follow Me‖ Multifunctional Automated Trolley and the research group hope the research would be a benefit for the developing supermarkets. Hope that this research study will be helpful for the researchers who interested in the automated systems as well as software building and will develop similar models with more advance technologies and features.

During the development of the project following are the limitations which were figured out:

a. Supermarket customers should be used to an automated environment;

b. –Follow Me‖ trolley detects only the closest object when travelling automatically;

c. Lithium battery life;

d. Trolley only detects the black and white path when it comes to automatic parking;

e. Server must work 24/7 accurately in order to access the

developed android and desktop applications;

–Follow Me‖ Multifunctional Automated Trolley system have some limitations but the research group did some work to overcome the above mentioned issues.

a. Battery of the trolley must charge when it is parked in the slot;

b. Distance of the object identification has given a small distance so that the trolley identifies the only the customer who is near to the device;

c. Parking of the trolley only detects the black and white path so that the black and white must be drawn in supermarkets to work the automatic parking methodology;

d. Since the server is hosted the applications can perform their tasks 24/7;

INTEGRAL UNIVERSITY, LUCKNOW
I. C. P. E.

CHAPTER 6- FUTURE WORK

Recommendations to those who are willing to develop this system further are as follows:

a. Setting up a navigation map to the application to identify the where the products are been stored.
b. Promoting the application to customer own mobile device.
c. Sending SMS or E-Mail after the purchasing is finished.

d. Add a payment method which is fixed to the trolley to pay using customers debit or credit card.
e. Developing a tag which uniquely identifies only the specific customer.

As the research was limited to a specific time period the group was able to focus only a limited amount of components. In the future the group is willing to do more researches and develop more methods that will be included to the hardware device as well as to the android application.

REFERENCES

[1] ,. H. ,. D. K. S. R. &. S. K. Mr. Yathisha L, "AUTOMATION OF SHOPPING CART TO EASEQUEUE IN MALLS," [online].available:

https://www.irjet.net/archives/V2/i3/Irjetv2i3217 .pdf, International Research Journal of Engineering and Technology (IRJET), vol. 02, no. 03, pp. 1435-1441, june-2015. [Accessed: July2016].

[2] S. D. S. M. Kalyani Dawkhar, "Electronic Shopping Cart For Effective Shopping based on

RFID," [online] available: https://www.ijireeice.com/upload/2015/january/IJ

IREEICE17%20a4%2057.pdf, INTERNATIONALJOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING, vol. 3, no. 1, pp. 8486, January 2015. [Accessed: July-2016].

[3] S. Z. k. J. k. P. A. S. Z. Arbaaz Khan, "Smart Trolley Using

QR Code,"[online] available: http://www.researchpublish.com/download.php ?f

ile=Smart%20Trolley%20Using%20QR %20Code-2470.pdf&act=book, International Journal of Computer Science and Information Technology Research, vol. 3, no. 4, pp. 218-224, October - December 2015.

[4] S. M. R. T. R. G. Satish Kamble, "Developing a Multitasking Shopping Trolley Based On RFID Technology,"[online] available: http://research.ijcaonline.org/icccmit2014/numbe r3/icccmit7026.pdf,

[5] K. G. K. R. Raju Kumar, "Intelligent Shopping Cart,"[online] available: http://www.ijesit.com/Volume%202/Issue%204/I JESIT201304_64.pdf, International Journal of Engineering Science and Innovative Technology (IJESIT, vol. 2, no. 4, pp. 499507, July 2013.

[6] D. J. S. P. S. Dhavale Shraddha D., "IOT Based Intelligent Trolley for Shopping Mall,"[online] available:

[7] https://www.ijedr.org/papers/IJEDR1602225.pdf, International Journal of Engineering Development and Research, vol. 4, no. 2, pp. 1283-1285, 2016.

[8] H. P. B. ,. S. R. ,. S. M. Vinutha M, "SHOPPING AND AUTOMATICBILLING USINRFID TECHNOLOGY," [online] available: http://www.iaeme.com/MasterAdmin/UploadFol der/SHOPPING%20AND%20AUTOM ATIC%20BILLING%20USING%20RFID%20T ECHNOLOGY/SHOPPING%20AND% 20AUTOMATIC%20BILLING%20USING%20 RFID%20TECHNOLOGY.pdf, Journal Impact Factor, vol. 5, no. 8, pp. 132-138, August 2014.

[9] H. T. Y. K. S. K. Taishi ONOZATO, "A Control System for the Robot Shopping Cart,"[online] available: http://leo.nit.ac.jp/~tamura/pdf/1780.pdf, pp. 907910, 2010. [Accessed: september-2016].

[10] "AUTOMATEDSHOPPING TROLLEY,"[online] available: http://ijarbest.com/mmadmin/conference/spcl10/d ocument_2_DCTT_10032016.pdf, March 2016.

[11] S. R. J. B. Udita Gangwal, "Smart Shopping Cart for Automated Billing Purpose using Wireless Sensor Networks," [online] available: http://research.ijcaonline.org/icccmit2014/number3/icccmit7026.pdf, IARIA, pp. 168-172, 2013.

[12] S. L. K. A. D. M. L. P. T. C. W. T. Yen Leng Ng, "AUTOMATIC HUMAN GUIDED SHOPPING TROLLEY WITH SMART SHOPPING SYSTEM," [online] available: http://portal.fke.utm.my/fkelibrary/files/ngyenleng/2014/898 NGYENLENG2014.pdf, Journal Teknologi, vol. 73, no. 3, pp. 49-56, June 2014.

[13] P. V. G. B. G. R. Varsha Jalkote, "Futuristic Trolley for Intelligent Billing with Amalgamation of RFID and ZIGBEE,"[online] available: http://research.ijcaonline.org/icrtet/number5/icrtet 1357.pdf, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), vol. 12, no. 3, pp. 7284, (May - Jun. 2015.

[14] S. S. H. S. R. Jaspreet Kaur Raina," AUTOMATED CART NAVIGATION USING ACTIVE RFID AND Lab VIEW"[online] available: http://www.ijaerd.com/papers/finished_papers/12 002.pdf, Journal impact factor, pp. 916,2014.

[15] S. M. G. H. S. S. B. S. B. M. P. N. K. Gaikwad Payoj Dilip, "Intelligent Trolley for Automatic Billing in Mall Using Internet Server," [online] available: http://www.researchpublish.com/download.php?file=Intellige nt%20Trolley-3316.pdf&act=book, International Journal of Computer Science and Information Technology Research, vol. 4, no. 1, pp. 22-25, January-march 2016.

[16] Pololu Robotics & Electronics [online] available: https://www.pololu.com/product/1699,